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TITLE: Feature-region extraction method and feature-region extraction circuit

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PARENT-CASE:

RELATED APPLICATION

This application is a continuation of U.S. patent application Ser. No. 08/675,810 filed Jul. 5, 1996, now U.S. Pat. No. 5,748,776; which is a continuation of U.S. patent application Ser. No. 08/276,205 filed on Jul. 18, 1994, now abandoned.

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	APPL-DATE
JP	5-178250	July 19, 1993
JP	5-323709	December 22, 1993

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Detailed Description Text - DETX (8):
The present invention provides a method for **extracting a face-region,** utilizing the characteristic that **skin-color** components occupying most of one's face-region as shown in FIG. 5, concentrate on a small color difference region (hatched portion) within the color difference region defined by a coordinate system indicating a U-signal level on a vertical axis and a V-signal level on a horizontal axis. As shown in FIG. 6, the small color difference region is made a common region by binarizing two color difference signals of an image through the specific thresholds and then extracting a face-region therefrom. In short, this method is made to **extract a face-region** on the basis that its feature (**skin) color** is apt to concentrate on a small color difference region (enclosed by, line segments C.sub.HU, C.sub.LU, C.sub.HV, C.sub.LV) within a coordinate system indicating a U-signal level on a vertical axis and a V-signal level on a horizontal axis.

Detailed Description Text - DETX (9):
Even if the **skin color** that occupies most of a human face-region is distributed among a plurality of small color difference regions (e.g. the area A enclosed by line segments C.sub.HU1, C.sub.LU1, C.sub.HV1, C.sub.LV1 and an area B enclosed by line segments C.sub.HU2,

C.sub.LU2, C.sub.HV2, C.sub.LV2 as shown in FIG. 7) within a coordinate system indicating a U-signal level on a vertical axis and a V-signal level on a horizontal axis as shown in FIG. 7, it is possible to **extract the face-region** exactly without error. Indeed, since human **skin color** components may be distributed among a plurality of small color difference regions of, e.g., whitish, blackish or any other hue, it is desirable to **extract a face-region** by the method of the present invention.

Detailed Description Text - DETX (11):

The feature-**region main-portion circuit 1** **extracts a skin-color region** occupying the major portion of one's face-region. This circuit 1 can be composed of a memory 4 such as a random access memory, a read-only memory and so on. The memory 4 stores two color difference signals U and V which are connected to its addresses A15-A8 and A7-AO respectively. In the memory space represented by 16-bit addresses, one area corresponding to the hatched region of FIG. 5 is filled with the digit 1 (logical one) and other regions are filled with the digit 0 (logical zero). Accordingly, an output D of the memory 4 is 1 when the signals U and V are signals of a skin-color region corresponding to the hatched region shown in FIG. 5, and changes to 0 when the signals U and V relate to a region other than the face's. The main portion of a face-region can be thus extracted. However, a face-**region extracted at this step lacks the**

regions such as the eyes, the eyebrows and the lips, differing in **color from the skin-color** portion. Furthermore, it may also include a region or regions other than the face-region, which were erroneously extracted because of noise or the like.

Detailed Description Text - DETX (13):

The comparison circuits 5 to 8 compare two color difference signals (U and V) with the upper and lower limit thresholds C.sub.HU, C.sub.LU, C.sub.HV, C.sub.LV. The comparison circuit 5 provides an output signal having the logical value of 1 when U.ltoreq.C.sub.HU. Similarly, the comparison circuits 6 to 8 provide output signals having a logical value of 1 respectively when U.gtoreq.C.sub.LU, V.ltoreq.C.sub.HV and V.gtoreq.C.sub.LV. Output signals of these comparison circuits 5 to 8 are passed to the AND gate circuit 9 which provides a logical product of the output signals, extracting therefrom a common region. Consequently, the output of the AND gate circuit includes the logical value of 1 for the skin-color region enclosed by line segments C.sub.HU, C.sub.LU, C.sub.HV, C.sub.LV shown in FIG. 6. A main portion of a face**-region can be thus extracted, but it lacks the regions** such as the eyes, the brows and the lips, differing in **color from the skin-color** portion and may also include a **region or regions other than the face-region, which were erroneously extracted** because of a noise or the like.

Detailed Description Text - DETX (16):

The outputs of the AND gate circuits 14 and 19 are passed to the OR gate circuit 20 which provides a logical sum of the outputs. Consequently, the output of the OR gate circuit 20 is a logical value of 1 for both the feature-region A enclosed by line segments C.sub.HU1, C.sub.LU1, C.sub.HV2 and C.sub.LV2 and the feature-region B enclosed by line segments C.sub.HU2, C.sub.LU2, C.sub.HV2 and C.sub.LV2 as shown in FIG. 7. The main portion of a face-region can thus be extracted with no error even if an attribute of a feature-region is distributed among a plurality of regions within a coordinate system indicating a U-signal level on a vertical axis and a V-signal level on a horizontal axis. However, the face**-region extracted at this step lacks the regions** such as the eyes, the eyebrows and the lips, differing in **color from the face's skin-color** portion and may also include a **region or regions other than the face-region which were erroneously extracted** because of a noise or the like.

Detailed Description Text - DETX (25):

Similarly with the case of the embodiment of FIG. 4, the feature**-region main-portion extracting** circuit 21 **extracts a skin-color region,** occupying most of one's face-region. The **extracted face-region,** however, lacks different color regions such as the eyes, the eyebrows and the lips, and may include an

region other than the face which was erroneously detected as a **skin-color** region because of a noise signal. Therefore, an extraction signal generated by the feature-region main-portion extracting circuit 21is sent to the small region eliminating circuit 22 whereby a small region, erroneously extracted due to the effect of a noise signal, is eliminated from the extraction signal. The output of the small region eliminating circuit is stored to the frame memory 24 and a signal delayed by one frame is, returned to the small region eliminating circuit 22.